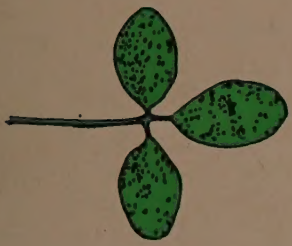
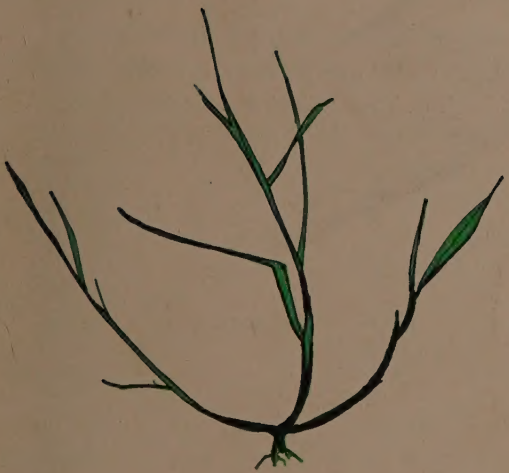


Diseases of Forage Crops



by S. B. Fenne
Extension Plant Pathologist

Bulletin 188

Revised, January 1960

V. P. I. Agricultural Extension Service
Blacksburg, Virginia

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ACKNOWLEDGMENTS

Thanks are due A. S. Williams of the V. P. I. Department of Plant Pathology and Physiology for valuable suggestions and assistance in the preparation of this bulletin; and to K. W. Kreitlow, J. H. Graham and R. J. Garber for the liberal use of material in Bulletin 573, "Diseases of Forage Grasses and Legumes in the Northeastern States," published in 1953 by the Pennsylvania State University Agricultural Experiment Station, University Park, Penna.

Plates 1, 2, and 3 are from the 1953 U.S.D.A. Yearbook. In Plate 4, pictures A, B, C, D, and F were made by A. S. Williams, V. P. I., and picture E by J. C. Wells, North Carolina Extension Service.

Virginia Polytechnic Institute and the United States Department of Agriculture Cooperating: Extension Service, L. B. Dietrick, Director, Blacksburg, Virginia

PRINTED AND DISTRIBUTED IN FURTHERANCE OF THE ACTS OF CONGRESS OF MAY 8 AND JUNE 30, 1914

RP—11-60—5M—13—3—LM

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Diseases of Forage Crops

S. B. Fenne, *Extension Plant Pathologist*

The increased acreage of legumes and grasses now being grown on Virginia farms has greatly magnified the disease control problem of these crops. A single foliar disease, such as Pseudopeziza leafspot of alfalfa, may cause 30% or more of the leaves to fall prematurely; yet this is only one of more than 20 diseases that attack alfalfa. Some diseases attack plants and reduce yield only by a very small precentage in any one season. However, repeated attacks frequently weaken plants so that they may be attacked and killed by other organisms.

The purpose of this bulletin is to summarize the latest information on forage crop diseases. Additional information may be obtained on specific crop diseases from the many state and federal experiment station publications.

Forage crop diseases are caused by bacteria, fungi, viruses, nematodes and parasitic seed plants, and can usually be controlled or held in check by proper treatment. Chemical sprays and dusts are not widely used on forage crops because of the poison hazard to livestock and the high cost of spray materials when compared with the low per-acre value of these crops. Some disease organisms live for long periods in the soil, others on the residue of dead plants, and still others remain within diseased living plants and become sources of infection to neighboring plants. For this reason crop rotation is a very important means of reducing damage from many forage crop diseases, especially soil-borne diseases. Although resistant varieties are at present the best means of controlling diseases, no such varieties exist for many of the most destructive diseases. Good farm practices, crop rotation, clean cultivation, and plowing under old, diseased plant material, help to reduce the amount of plant diseases by destroying the inoculum.

Since vigorous plants are better able to withstand attacks of pathogens, adequate soil fertility should be maintained. In all cases it is very important to use recommended adapted varieties and to follow the best known agronomic practices in regard to fertilization and management. In some cases chemical seed treatment has proved to be very helpful. If foliar diseases strike early and severely it is sometimes best to harvest the stand earlier than normal to remove as much of the diseased material as possible.

GENERAL DISEASES FOUND ON MOST LEGUMES

Anthracnose

Two different fungi cause anthracnose on legumes—southern anthracnose (*Colletotrichum spp.*) and northern anthracnose (*Kabatiella caulivora*).

SOUTHERN ANTHRACNOSE is the most destructive disease of clover in Virginia, and it may completely destroy stands. The causal fungus is primarily a high-temperature organism (82°F.), which explains why this disease is more prevalent in the Southern states. This disease also occurs on alfalfa (Fig. 1), crimson clover, and white sweet clover, but has not been observed on white (Dutch) clover. Alsike clover is immune. Leaf symptoms of southern an-

Figure 1.—Southern anthracnose on alfalfa.

thracnose are difficult to distinguish from those caused by the northern anthracnose fungus. However, southern anthracnose frequently attacks the upper part of the tap root and crown. This results in a crown rot or tap root decay that frequently weakens or kills affected plants. Diseased crowns often become so brittle that stems break off at the soil level. Tissues where the break occurs are usually discolored, brown to bluish-black.

Resistant strains of red clover have been developed in areas where this disease is prevalent. The Kenland and Chesapeake varieties are adapted to Virginia conditions and are moderately resistant. The most susceptible varieties of alfalfa are DuPuits, Narragansett, and Vernal, while Williamsburg and Atlantic are moderately resistant.

NORTHERN ANTHRACNOSE symptoms are quite similar to those of southern anthracnose. Northern anthracnose is restricted largely to clovers and occurs occasionally in Virginia. It develops best during wet, humid periods of spring and summer at temperatures of 68 to 77°F. The northern anthracnose fungus does not attack alfalfa but has been reported on black medic, alsike, white, and crimson clovers.

Symptoms are confined chiefly to the petioles and stems (Plate 2, lower right), although leaflets are occasionally affected. Dark brown to black spots which become light colored with dark margins are usually the first symptoms. The center of these lesions frequently cracks or the lesion may girdle and kill the steam. Lesions on the petioles cause the leaf to wilt and the petiole to bend over in a typical "shepherd's crook." Severely affected plants look as if they were scorched with fire.

It is doubtful if the fungus is transmitted on or in the seed, and there is no evidence that the disease is soil borne. The fungus overwinters in perennial

green stems or in dormant tissues of the crown. The disease may also survive in old infected stems. In the spring, wind and splashing rain carry spores from diseased lesions to healthy plant parts. Locally adapted varieties offer the best means of control.

Blackstem

Spring blackstem, caused by *Ascochyta spp.* and *Phoma spp.* is in complex of diseases affecting alfalfa and clovers (Plate 1 lower right and Fig. 2). Spring blackstem is more destructive on alfalfa than on any other crop. Disease development is frequently severe during cool, wet weather of early spring. In cool seasons damage extends into early summer. The infection may spread extensively later in the fall but stem blackening is less pronounced at that time. The blackstem fungus attacks the leaves, petioles, and stems frequently causing defoliation, lower yield and quality of forage, and death of plant parts. In early spring small brown to black spots develop on the stems and leaves. Young lesions on the stems are first outlined by watery borders. During the growing season they enlarge and join together until much of the stem is blackened. Diseased leaves turn yellow and soon wither and fall. From late fall until early spring numerous raised brown to black fruiting bodies are visible on the dead stems and petioles.

The fungus overwinters principally on plant residue. In early spring spores exude from the fruiting body and are splashed by rain onto new shoots. The fungus also lives within the seed and in the soil, thus providing several sources of infection. If severe infection occurs in the spring, early harvesting to remove the diseased growth helps to reduce secondary infection. In addition, an adequate amount of potash should be applied, because plants growing in soil low in potash will likely be more severely damaged by blackstem. Some

Figure 2.—Blackstem on alfalfa.

varieties of alfalfa are more susceptible to blackstem than others. Therefore, only recommended adapted varieties should be used.

Cercospora Leafspot *(Cercospora spp.)*

Cercospora leafspot (Plate 1 lower left) occurs extensively on legumes and is sometimes very severe on alfalfa and white clover during summer and early fall. Damage varies from year to year, depending on weather conditions. This disease is sometimes called summer blackstem. Leafspots range in color from light brown to almost purplish-black. The spots are usually rectangular and lie between the veins of the leaf. When dew is on the leaves the lesions appear silvery from numerous spores produced by the fungus. Sunken lesions may nearly cover the stems of diseased plants. When the spots enlarge the leaves shrivel, turn brown, and either drop off or die prematurely. The fungus persists on old stems, fruiting abundantly during warm, wet weather. Infection is initiated by spores spread by wind and rain.

Removing old crop residue and clipping or grazing when the disease is severe will reduce damage to the next crop. Resistant varieties are being developed.

Cold, Heat, and Drought Injury

Cold injury is common on alfalfa and clover. Extremely low temperatures are not necessary for injury. When alfalfa or clovers start growing vigorously in the early spring and the temperature suddenly drops, severe injury frequently results. The crown and root tissues of alfalfa and clover are damaged by low temperatures and drying. Injury from heaving frequently occurs as a result of alternate freezing and thawing. Winter injury may occur on extensive areas in some fields. Slightly injured plants are damaged further by the entrance of fungi and bacteria before the injured tissues recover.

Cold injury may be largely prevented by the use of adapted varieties that are cold resistant and by proper crop management. Varieties that continue active growth until late in the winter often suffer from cold injury. Late fertilization will also tend to aggravate this situation. Crop management practices that will insure adequate storage of food reserves in the crown and roots are essential to winter survival and recovery in the spring. Continuous pasturing and frequent cutting, especially late in the autumn, cut down the reserves that are necessary for plant development and winter survival. Varieties of clovers vary greatly in their resistance to cold injury. Many of the winter-hardy varieties are the result of "survival of the fittest" during the process of adaptation.

Heat and drought injury symptoms frequently are quite similar to those caused by cold injury.

Crown and Stem Rot *(Sclerotinia trifoliorum)*

Crown and stem rot is one of the most common diseases of legumes in the eastern part of the state (Plate 4, E). Crown and stem rot is chiefly responsible for the early killing of stands. Damage is frequently severe in the early spring when the temperature and moisture conditions are most favorable for development of the disease. Crown and stem rot appears first, in new fall plantings, when the plants are still small. Brown spots may appear on the leaves during wet periods. Heavily infected leaflets drop. The infection later spreads downward to the crown and roots. The new growth of infected

plants frequently wilts, and under conditions of high moisture and dead tissues are overrun with a heavy white mold. Later these dense white moldy growths at the base of the stems become transformed into irregular hard, black bodies, called sclerotia. These sclerotia are sometimes as large as a pea and provide a positive diagnosis of the disease. The sclerotia lie dormant in the soil until suitable conditions for germination occur. Fruiting structures are then formed which produce numerous spores that are blown through the air and cause new infections on nearby susceptible plants. Some sclerotia remain dormant in the soil for several years.

Because of the longevity of the sclerotia in the soil, this disease is difficult to control. Planting seed free of sclerotia, clean cultivation, deep plowing to bury sclerotia beyond their capacity to develop fruiting bodies, and long rotations aid in controlling crown and stem rot. Using adapted varieties is also an aid in reducing damage due to this disease.

Dodder *(Cuscuta spp.)*

Dodder is a plant that is parasitic on many legumes and several other plants. It is especially prevalent on lespedeza (Fig. 3). Dodder may cause considerable damage and should not be allowed to grow unmolested. Dodder is usually introduced on a farm by planting impure crop seed, feeding infested hay, drainage water carrying pieces of dodder stems and seeds, and seed carried in stable manure. One of the major sources of dodder-infested crop seed is from the combine owner who harvests a crop and sells his toll seed directly from the machine. It is very difficult to remove dodder from other seed by screening.

Dodder seed germinate in the soil and use their stored up food in produc-

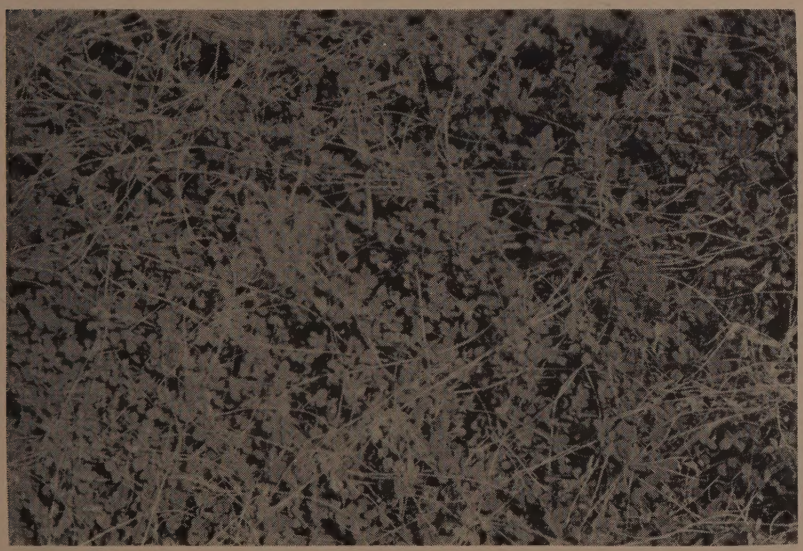


Figure 3.—Dodder on lespedeza.

ing a shoot 4 or 5 inches long. The leafless and almost rootless shoot rotates until it comes in contact with a suitable host plant. If the seedling does not come in contact with a suitable host its temporary stem lies dormant on the soil for 4 or 5 weeks and then dies. A dodder shoot that comes in contact with a host plant begins to climb by encircling it, thereby making close contact with the stem of the plant. Small suckers (haustoria) grow out of it like warts and penetrate the food-conducting tissues of the host plant. These haustoria secrete a substance that dissolves the starchy materials in the host cells from which they withdraw the food the dodder plants use for growth. After the two plants become united, the base of the dodder stem shrivels and dies and the dodder plant loses all contact with the ground. From that time on the parasite obtains all of its food and water at the expense of the host plant.

The dodder plant continues to climb and branch out. Soon its branches begin to attack nearby plants. A single dodder plant may eventually form a patch many feet across. Frequently the plants first attacked are killed back to the roots. This causes the parasites on them to die, but it does not affect those that have spread to host plants at the edge of the infested area. As new growth develops from the crowns of the affected crop plants, it is again attacked either by the older dodder plants or by seedlings recently germinated in the soil. Again the top growth of the crop plants is killed. Frequently, after several attacks the host plant dies.

Dodder blooms from late spring until frost. Seed is formed in great abundance during the summer and matures until frost. Some dodder seed germinate immediately after falling to the ground, but much of it lies dormant on the soil surface for periods up to 5 years or more and then germinates. Half-ripe dodder seed germinate as readily as those that have matured, but they may not remain viable as long in a dormant stage. In most areas dodder overwinters by means of seed. In areas free of severe frost, some plants overwinter in stems of the host, especially if they are protected from freezing by a covering of soil or crop residue. Such overwintered plants begin to grow again when favorable weather occurs.

There are several practices that help in controlling dodder, such as: Sowing crop seed that are free of dodder; thoroughly cleaning the combine or other farm equipment before moving it from a dodder-infested field to one not infested; destroying hay containing dodder seed, or making it into meal or silage; and not spreading manure from cattle-fed dodder-infested hay.

One of the most effective methods of controlling dodder is to make spot treatments by spraying or by burning with a weed burner or torch. 2,4-D sprays have been used successfully on annual lespedeza. Such a treatment is cheaper than using weed oils and/or other contact herbicides, but treatments that kill dodder will generally kill the host plants as well. For detailed information on the best methods of controlling dodder, see Farmers' Bulletin No. 2117, "Dodder and Its Control."

Pseudoplea Leafspot *(Pseudoplea trifolii)*

Pseudoplea leafspot is quite common on alfalfa (Plate 4, F) especially during humid, warm periods. Numerous small sunken black spots first occur on leaves and petioles. Later these enlarge on leaves to form sunken, gray-centered, reddish-brown bordered spots which contain numerous small black perithecia (fruiting bodies) embedded in the gray tissue. Ascospores serve as

the only means of infection. These can be produced throughout the spring and summer during periods of cool, moist weather. The organism apparently overwinters as perithecia on dead but undecayed leaves.

On clovers, Pseudoplea leafspot is called pepper spot. It is somewhat inconspicuous but the damaging effects of the disease soon become apparent. Although the disease is most frequently observed on Ladino and white clovers, other species of clover are attacked in humid, temperate areas.

Rootknot *(Meloidogyne spp.)*

Rootknot, the common nematode disease forming root galls, is familiar to most farmers. This nematode attacks more than 1,400 species of plants. In fact, most field, garden, ornamental, and fruit crops (except grains, grasses, and special resistant strains of other plants) are susceptible. Of the various legumes, lespedeza is the most susceptible (Fig. 4), although rootknot is frequently found on clovers and alfalfa. Infected plants are stunted. They often wilt, turn yellow and die. The chief diagnostic symptom is the presence of swellings or galls on the roots. These may be nearly round or long and irregular. Rootknot galls can be distinguished from legume nodules, produced by nitrogen-fixing bacteria, by the fact that the rootknot nematode is an actual part of the root and cannot be broken off, while the desirable nitrogen fixing bacterial nodules are formed at one side of the root and can be readily broken off.

Rootknot nematode larvae develop to maturity and mate within the root gall. The female is pear-shaped, white, glistening, and can be seen as a white dot with the unaided eye. The female nematode extrudes a sac full of brownish eggs. Just before hatching the larva can be seen under the microscope

Figure 4.—Rootknot on lespedeza.

coiled up inside the egg. Each female lays from 500 to 2,000 eggs in the course of 2 or 3 months. The larvae move from the decaying knot and secrete a chemical that stimulates the formation of a gall or knot around the larvae at a new infection center. At high temperatures (about 80°F.) a generation takes only about 25 days, while below 50° activity stops. The adult female cannot live long outside its host gall, but free-living larvae can survive in the soil for several months without food, and eggs can survive up to 2 years. The larvae and eggs are spread in infested root crops, in infested soil transported on tools and equipment, and by drainage water. Rootknot nematodes are most numerous in light, sandy soils which allow them free movement, although they seldom travel more than a foot a month. Nematodes are usually only 3 to 10 inches deep in the soil, but they have been found at depths of 6 feet or more in connection with deep-rooted plants.

Fortunately legumes are not as susceptible to rootknot as many other crops, and therefore the problem of controlling the rootknot nematodes is simpler for legumes than for other crops. Usually a rotation wherein legumes do not follow susceptible crops (especially vegetables) is sufficient.

Root Rot Disease Complex

Root rot is one of the principal factors limiting production of legumes (Plate 2, lower left). Several different organisms may attack the root. Most commonly found are species of *Fusarium.* Symptoms first develop on the leaves, which may curl, then turn gray and wilt. The tap root is frequently discolored, light brown to black, and may become completely rotted. New roots are attacked as rapidly as they replace the older damaged roots. Root rot fungi apparently enter plants principally through wounds caused by insects, winter injury, or mechanical injury to the crown.

Control is difficult, but following the best known cultural practices and management will help prolong the life of the stand.

Rust *(Uromyces spp.)*

Rust attacks clovers and alfalfa each year but damage is difficult to evaluate because infection usually occurs late in the season. Most of the newer improved varieties of clovers, even though they may be attacked by rust, are not usually as severely affected as the older "non-improved" varieties. Rust symptoms on all clovers are very similar. A few pustules on the lower leaf surface usually cause no visible damage; however, if the pustules are numerous and well developed the upper surface of the affected leaf becomes reddish-brown to yellow. The leaf then curls or withers and dies. Petioles may also be affected, cutting off the supply of nutrients to the leaf. This hastens death and reduces the quality and yield of forage.

Rusts are differentiated by their host range. The variety of rust on alfalfa or on one clover frequently does not affect other clovers. Most of the legume rusts differ from cereal rusts in their life cycle, in that they do not require an alternate host, such as barberry in cereal rusts. In late winter or early spring, infection occurs from the overwintered spores in diseased derbis. Under favorable conditions the fungus develops rapidly and spreads to neighboring plants. The spores are wind-borne and can infect plants under conditions of limited moisture, requiring only periodic heavy dews. Since rust spores can germinate over a wide range of temperatures, they can develop when certain other disease organisms cannot.

Stemphylium Leafspot *(Stemphylium spp.)*

Leafspot caused by the fungus S. *Botryosum* is common on many legumes, but especially on alfalfa (Plate 4, C and Plate 2, upper right.) It is very serious in wet years, especially in dense stands. The fungus attacks all of the above-ground parts of legumes, including leaves, stems, petioles, peduncles, flowers and pods. Another Stemphylium leafspot, *S. sarcinaeforme*, is severe on red clover (Plate 4, D). Leaf lesions become large, irregular in shape, brown to dark brown in color, and are usually surrounded by a yellow halo. During moist periods these lesions become blackened by the tremendous numbers of conidia (spores) produced. The leaves appear water-soaked. Lesions commonly coalesce to form large diseased areas, with concentric rings often developing in the older lesions. Black lesions appear on stems and petioles. During wet periods these lesions elongate, coalesce, and frequently girdle stems and petioles, causing their death. Usually a single large lesion causes the leaf to yellow and fall prematurely. The fungus overwinters on seed and plant refuse. Unadapted varieties are very susceptible to Stemphylium.

A different species, *S. loti*, causes a stem canker and leafspot on birdsfoot trefoil. During wet, humid weather leaf lesions become reddish-brown, slightly sunken, and round or semi-circular. Later the spots darken, increase in size, and become concentrically zoned. On stems copper-colored cankers varying in size from dots to an inch or more in length are encircled by a water-soaked border. The fungus may also cause irregular brown discolorations on pods and seed. It can overwinter on dead stems, where numerous spores are produced the following spring. The fungus is also seed-borne. Strains of the fungus affecting birdsfoot trefoil will not attack red clover or alfalfa, and the strains that cause diseases of these plants will not attack birdsfoot trefoil.

Virus

Most legume visuses have a wide range of hosts. Clover viruses also attack other legumes, and viruses of other legumes attack clovers. Some viruses from non-legume hosts, such as tobacco, potatoes, and some weeds, can readily infect clovers. This means that many of the virus diseases are spread from one kind of crop to another. The extent and amount of infection usually depends on the kinds and number of insects present. Aphids are probably the most important carriers. All common clovers are susceptible to several viruses, some of which are widely distributed (Plate 1, upper left).

Most of the clover viruses are systemic; that is, they are present in all parts of the plant. The most conspicuous symptoms are usually found in the leaves. They include vein chlorosis, mild to servere mottling, chlorotic patches between the veins, and other abnormal combinations. Sometimes the leaves are curled, puckered, or ruffled. Some viruses causes a reduction in vigor, as indicated by a general stunting of the plant. Others have no apparent effect on vigor. Viruses that have little effect on one species of plant may kill another kind. Symptoms of most virus dicases are conspicuous during the cooler periods of the growing season. Sometimes they appear for short periods of time and become masked during hot weather. Weakening caused by virus diseases may predispose such plants to attack by other pathogens (especially those that cause root rots and wilts) or prevent them from surviving severe winters and prolonged droughts.

Alfalfa is frequently infected with mosaic, which is conspicuous as a mottling of the foliage in spring or autumn. Symptoms usually disappear in mid-

summer. Mosaic may not be of economic importance on alfalfa but it often serves as an overwintering host, from which aphids carry the virus to annual legumes in the spring. Pea mottle virus and alsike clover mosaic virus may also be found on alfalfa.

Little has been done to control virus diseases of legumes. Some of the newer insecticides are very effective in killing the insect vectors. Whenever possible, alfalfa and clovers should not be grown close to other legumes (particularly peas or beans). The ultimate solution is to develop varieties resistant to the most prevalent and injurious virus diseases.

Yellowing, Leaf Discoloration, and Dwarfing (non-parasitic)

Several types of yellowing and other discoloration of foliage and shortened stem growth are common on alfalfa and sweet clover. Frequently the symptoms and plant responses are similar to those caused by a number of unfavorable environmental conditions. These causal complexes cannot be determined without careful study of past and present environmental conditions. Deficiency of mineral nutrients has an accumulated effect and frequently crop production is seriously reduced before symptoms are fully expressed. BORON DEFICIENCY, frequently results in dwarfed plants, short terminal internodes, death of terminal buds, and yellow to bronze foliage (especially in alfalfa). These symptoms differ from the marginal yellowing and white spotting of leaflets due to POTASH DEFICIENCY and are somewhat less distinctly differentiated from LEAF HOPPER INJURY. Potato leaf hoppers cause yellowing and dwarfing of alfalfa. The leaflets turn yellow and frequently brown along the margins. A reduction in plant vigor, crown bud development, and root survival may result. Yellowing and stunting of legume plants may occur as a response to other unfavorable environmental conditions, such as HEAT AND DROUGHT. The abnormal appearance of affected plants may be localized or widespread in a field or area. Floral buds are often retarded and under severe conditions they yellow and dry out.

MINERAL DEFICIENCIES are expressed by various types of leaf discoloration and spotting. The use of plant symptoms to diagnose specific mineral deficiencies is risky, because frequently several different causes produce similar symptoms. ZINC, COPPER, AND MOLYBDENUM deficiencies show symptoms somewhat similar to those caused by boron deficiency. Low potash may cause yellow blotches and leaflet yellowing, which is frequently similar to the yellowing produced by other causes. LOW PHOSPHOROUS usually causes a purple discoloration, especially of new growth.

Another cause of yellowing, especially of alfalfa, is due to the LACK OF NODULATION. Even though alfalfa seed may have been properly inoculated before planting, it does not mean that nodules are present on the plants. If the soil was dry at the time of planting, nodule-forming bacteria are frequently killed. It takes only a few hours exposure to dry soil or bright sunshine to kill these bacteria. Alfalfa seed can remain dormant for a couple of weeks, and with suitable moisture they will germinate and make an excellent stand. Alfalfa plants will appear green and healthy looking until the nitrogen applied at the time of seeding has been used up, then the young plants will turn yellow and stop growing. A careful examination of the roots of such yellowed plants will show that nodules are not present on the roots of yellowed alfalfa while they are numerous on the roots of green alfalfa. Too acid soil will make conditions unfavorable for the growth of legume bacteria and may contribute to the lack of nodulation.

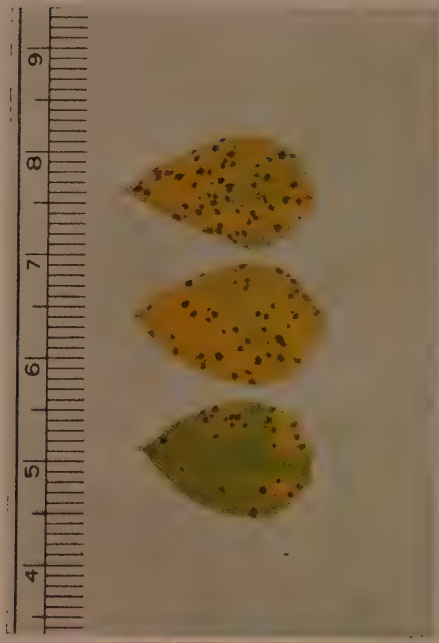
PLATE 1

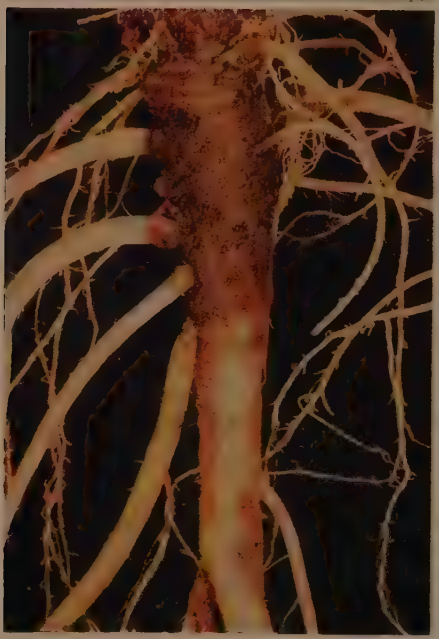
UPPER LEFT
Top—Healthy red clover leaf.
Bottom—Virus infected.

UPPER RIGHT
Powdery mildew on red clover.

LOWER LEFT
Cercospora leafspot on Ladino clover.

LOWER RIGHT
Spring blackstem on red clover.





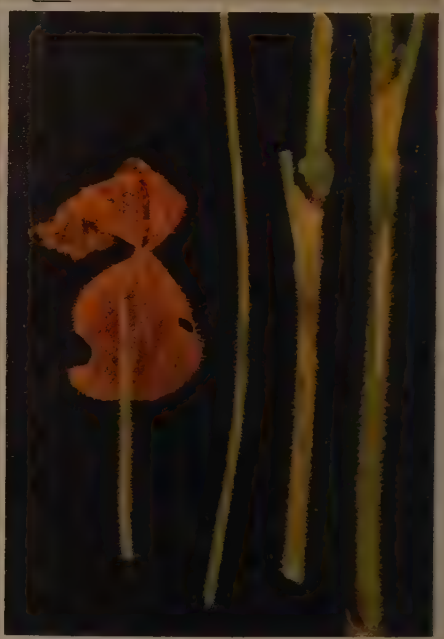


PLATE 2

UPPER LEFT
Common leafspot on alfalfa.

UPPER RIGHT
Pleospora leafspot on alfalfa.

LOWER LEFT
Root rot disease complex on red clover.

LOWER RIGHT
Northern anthracnose on crimson clover.

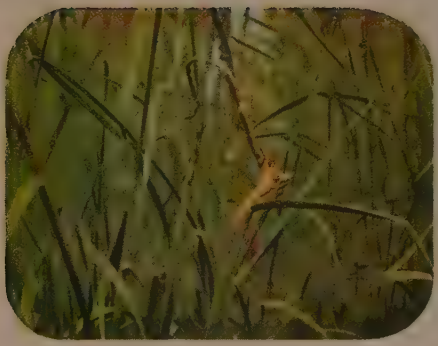
PLATE 3

UPPER LEFT
Helminthosporium leafspot on smooth bromegrass.

UPPER RIGHT
Stagnospora leafspot on orchard grass.

LOWER LEFT
Bacterial leaf blotch on smooth bromegrass.

LOWER RIGHT
Scald on smooth bromegrass.



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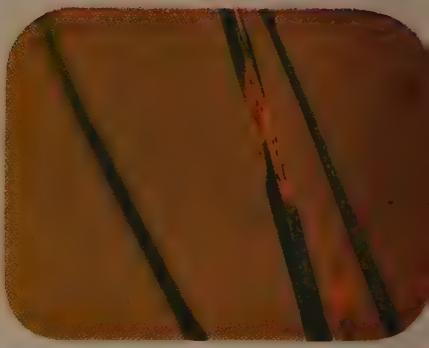

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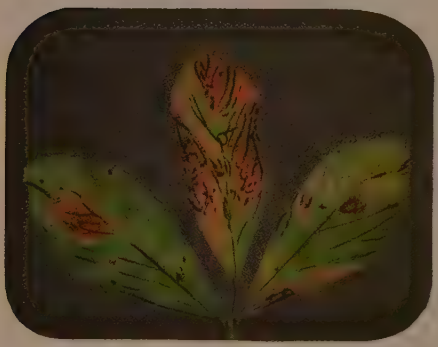

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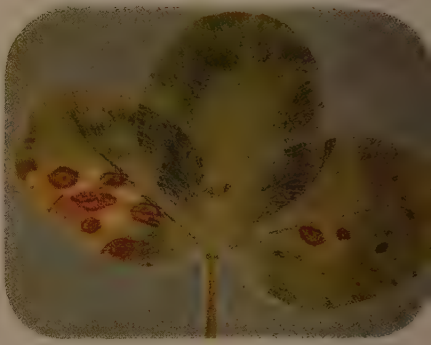

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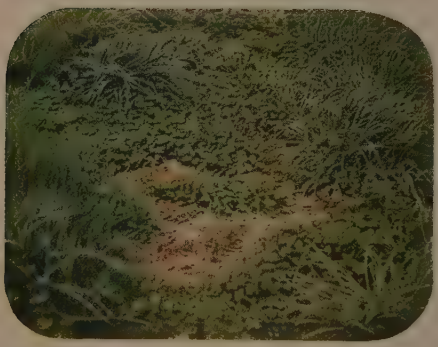

E

F

PLATE 4

A.—Yellow slime disease on orchard grass.

B.—Rust on orchard grass *(Puccinia gramnis)*.

C.—Stemphylium leafspot on alfalfa *(S. botryosum)*.

D.—Stemphylium leafspot on clover *(S. sarcinaeforme)*.

E.—Crown and stem rot on Ladino clover.

F.—Pseudoplea leafspot on alfalfa.

ALFALFA DISEASES

Bacterial Wilt *(Corynebacterium insidiosum)*

Bacterial wilt is found in many of the principal alfalfa growing counties in Virginia and is probably more widespread than is generally known. Bacterial wilt causes stunting and yellowing of the entire plant (Fig. 5). Shortened stems result in bunchy growth. The leaves are small chlorotic and often cupped. During warm, dry weather plants may wilt and die rapidly. At first only the tips of the stems droop, followed by more or less complete wilting and death. Stunting is most evident during regrowth following cutting, and progressively less growth is produced after each cutting. Severely diseased plants usually do not survive the winter. Alfalfa wilt can be identified by examining the tap root (Fig. 6). When the bark immediately below the crown is peeled, yellowish or pale-brown discoloration of the outer wood in contrast to the creamy white appearance of healthy wood characterizes infection. In recently infected plants the yellow stain extends downward

Figure 5.—Bacterial wilt of alfalfa.
Left, diseased plant; right, healthy plant.

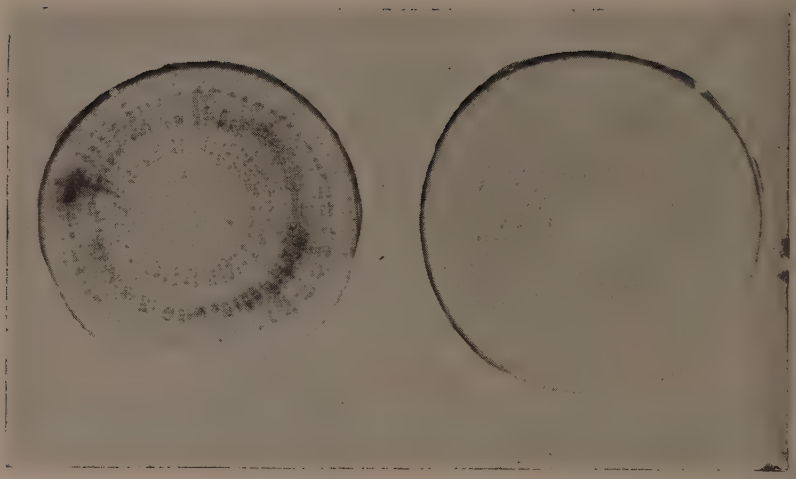

Figure 6.—Bacterial wilt of alfalfa. On the left is a cross section of a diseased root; on the right, a healthy root.

from the crown in streaks which merge into a continuous ring beneath the bark. If the tap root is cut across with a sharp knife, scattered discolored dots or a dark ring of discolored tissue is usually visible.

The bacteria causing this wilt enter the plant through wounds resulting from winter injury or by mechanical injury through harvesting operations or grazing. The water-conducting tissues are invaded and clogged by rapidly multiplying bacteria, which results in yellowing, stunting, and eventual death of the plant. In advanced stages of the disease, bacteria multiply in the crown and stems and are released into the surrounding soil water. Bacterial wilt is more frequently found in stands that are 3 to 4 years old. Rarely is this disease found in new stands; however, wilt may develop suddenly in fields of any age. Severe attacks on young plants may be traced to infection from older plants, winter injury, and abundant moisture in the spring. Alfalfa planted on wet, poorly drained soil is usually more susceptible to bacterial wilt than that grown on well-drained soil.

The use of resistant varieties is the only practical means of controlling wilt. Buffalo is quite resistant to bacterial wilt and is well adapted to Virginia conditions. Certified seed of this variety is available. In addition to using a resistant variety, the grower should follow cultural practices which aid in maintaining diseased stands and retarding disease development in new areas. Recommended cultural practices are to maintain high soil fertility levels, particularly potassium and phosphorous; prevent injuries to plant crown and roots; mow when plants are dry; avoid contaminating young healthy stems by mowing them before mowing older diseased fields; not reseeding old alfalfa fields until complete rotting of the infected alfalfa roots has occurred (3 to 4 years); and not seeding fields that receive surface drainage water from disease-infested areas.

Common Leafspot *(Pseudopeziza medicaginis)*

Common leafspot, or Pseudopeziza leafspot, is one of the most destructive leaf diseases of alfalfa, even though the plants may not be killed by the disease. Defoliation causes loss of vigor and reduces hay quality and yield. Usually the second and third hay cuttings are damaged more than the first. During cool, wet weather only the topmost leaves may escape infection, particularly if the plants are growing slowly. Small circular brown spots approximately 1/16 inch in diameter develop on the leaves (Plate 2, upper left). When the spots are fully developed the centers become thickened and tiny fruiting bodies develop. These fruiting structures are produced throughout the growing season except during prolonged dry weather. Spores are discharged and are carried by the wind to other plants. The fungus overwinters in dead undecayed leaves. It is believed that the pathogen is not seed-borne.

Although adapted varieties of alfalfa are only moderately resistant to common leafspot, resistant lines have been selected and are being incorporated into new varieties. Harvesting before severe defoliation occurs and destroying diseased plants in waste areas may reduce damage by removing sources of infection.

Downy Mildew *(Peronospora trifoliorum)*

Downy mildew attacks alfalfa during wet or humid weather, usually in the spring. It occurs more frequently on young plants, yellowing them and sometimes causing defoliation. The upper leaves are attacked first, and become light green in color. Later they turn yellow and become twisted and rolled (Fig. 7). A fine gray mold-like growth consisting of mycelium and fruiting structures often develops on the underside of leaves. The fungus is usually systemic in new shoots where it causes stunting and yellowing. The numerous spores produced on diseased leaves and shoots are spread by wind. In late fall resting spores are formed in the old diseased leaves, where they remain dormant during winter and germinate the following spring. The fungus also survives the winter as mycelium inside the plant and on seed.

The principal damage occurs to young alfalfa during the first year following seeding. To help avoid this damage, alfalfa should be seeded not later than December 1 in eastern Virginia and August 15 in other areas. Since downy mildew is a cool-weather disease and usually disappears with warm weather or around the time of the first cutting, control measures are seldom necessary.

Yellow Leaf Blotch *(Pyrenopeziza medicaginis)*

This disease is frequently present but is generally less destructive than common leafspot. In cool, moist weather the disease develops rapidly and damage may be severe. Yellow elongated blotches develop parallel to the leaf veins often extending from the mid-rib to the margin. Small orange-black fruiting bodies develop on the upper surface of the diseased areas. Diseased leaflets do not wither and die immediately, but after a period of wet weather considerable defoliation may occur. Dark brown blotches may occur on the stems. In late spring, spores from overwintered fruiting structures supply the inoculum for the first infection. Damage from the disease may be reduced by cutting or grazing the crop before much defoliation occurs.

Figure 7.—Downy mildew of alfalfa. A moldy growth appears on the leaves, the tops may become distorted and the leaves turn yellow.

Stem Nematode *(Ditylenchus dipsaci)*

The alfalfa stem nematode has been a serious problem in irrigated alfalfa areas of the western states for many years. It was not discovered in Virginia until 1948. Since then it has caused severe losses on scattered farms in several counties. It is quite likely that the alfalfa stem nematode is more widespread in Virginia than is known at present. The nematode causing this disease attacks a large number of crop plants; however, some plants are more susceptible than others. Most alfalfa varieties, including all of those recommended for Virginia, are very susceptible. Stem nematodes can ruin a good stand of alfalfa in three years. Damage to alfalfa is most noticeable in early spring during cool, wet weather. Crown buds infected with nematodes are swollen and distorted (Fig. 8). Such buds are brittle and break off easily. If the infected crown buds develop into stems they also will be swollen and distorted. Severely infected crown buds do not develop into stems and the plant soon dies. Alfalfa seedlings are also attacked and show characteristic symptoms of stunting, swelling, and distortion. Seedling damage quite often is severe during long periods of cool, wet weather.

Stem nematodes can live for a long time in infected alfalfa stems, even after they are cut. This means that these nematodes can spread rapidly over large

Figure 8.—Stem nematode of alfalfa. Note swollen buds and wrinkled tissue on buds.

areas when alfalfa hay is shipped from one part of the country to another. Stem nematodes may be spread locally by the feet of animals and by machinery, especially during the cool, wet spring months when they are most active. Nematodes are also carried in free-flowing water and are found to be most numerous in and along drainage routes. Once stem nematodes have spread into a new area they may live unnoticed on several host plants. When a more susceptible crop, such as alfalfa, is planted in the infested area they multiply rapidly. Red and white clovers may be infected but they are damaged very little.

The control of stem nematodes has not been completely worked out. However, there are several practices that will help materially in reducing the amount of damage from this disease, such as feeding hay cut from a known nematode-infested alfalfa field only on the same field from which it was harvested; being very careful when grazing animals or using equipment in an infested field not to spread nematodes to other fields; plowing up infested fields and planting to grain, other annual crops, or grass for at least 3 years; and not replanting alfalfa, red or white clover on these fields for at least 3 years.

CLOVER DISEASES

Blackpatch (unidentified fungus)

The blackpatch fungus attacks plants during warm, humid weather in spring and mid-summer. It can remain active and infect new growth during periods of drought, providing heavy dews occur at night. Blackpatch has been

reported on red and white clover, soybeans, cowpeas, kudzu, and blue lupine. All of the above-ground parts of the plant are affected but symptoms on leaves and stems are most conspicuous. Lesions on leaves of red clover somewhat resemble those caused by Stemphylium. They vary from brown to grayish-black, usually in the form of concentric rings. Greatest damage results from stem girdling beneath the flower heads or from direct infection of the flowers before the seed is fully developed. The fungus is seed-borne and may cause seedling blight. Nothing is known concerning survival of the fungus

Seed treatment with a fungicide will reduce the infection. If severe leaf infection occurs, losses in the next crop could be reduced by early harvesting to remove the inoculum. Crop rotation and deep plowing of diseased material are also helpful.

Curvularia Leafspot *(Curvularia trifolii)*

This disease may cause wilting and dying of clover leaves, especially on Ladino clover. Large yellowed areas may appear on infected leaves. They soon turn watery gray and translucent, then light brown. A yellowish band usually outlines the edge of the lesion. Diseased areas that originate on a leaf tip are sometimes V-shaped. The fungus can invade the entire leaflet, causing it to wilt and die. The organism does not attack stolons.

Grazing or clipping when the disease is first observed will remove much infected material, which will reduce the amount of inoculum to infect new growth.

Powdery Mildew *(Erysiphae polygoni)*

Powdery mildew is one of the most common diseases of red clover. It can attack plants at any stage of development, but is most severe during late summer and fall. The disease is favored by relatively dry weather. Frequent rains reduce its spread and development. Powdery mildew occurs on many hosts, including other species of clover. It is composed of many physiologic races, some of which may be restricted to specific hosts. The race of powdery mildew that attacks red clover cannot infect alsike and several other species of clover. Symptoms, consist of a light-gray to white powdery growth (Plate 1, upper right) on the upper surface of the leaf. Infected leaves remain green for some time but ultimately lose their color, appearing first yellow then brown and dry. The mycelium and spores are borne externally on the leaf surface. The numerous spores produced are carried by wind and air currents to neighboring plants. The disease probably overwinters as dormant mycelium within the host. Dusting with sulfur, while ordinarily impractical under field conditions, has been tried with some success in a few clover fields harvested for seed.

Sooty Blotch *(Cymadothea trifolii)*

Sooty blotch may be found on most species of clover. It is most severe in low, damp areas. Sooty blotch occurs during late summer and fall, producing olive-brown-black pustules which may cover most of the underside of leaves. Spores are produced in great numbers on mats of mycelium and are spread by wind and spattering rain. Infected leaves tend to curl and remain green; later they become yellow, brown, and wither. The overwintering stage of the fungus develops as a raised, black, warty area on leaves. These fruiting bodies contain spores which infect plants the following spring.

LESPEDEZA DISEASES

Leafspots *(Cercospora sp., Colletrichum spp., Glomerella sp.)*

There are a number of different leafspots that occasionally effect lespedeza. A discussion of various leafspots is given under Alfalfa and Clovers. Since leafspots are so widespread on lespedeza, the only control recommendations are to follow good rotation and sanitation practices.

DISEASES COMMONLY FOUND ON LEGUMES AND GRASSES

Rhizoctonia Foliage Blight *(Rhizoctonia solani)*

In addition to causing damping-off and various root rots, Rhizoctonia attacks the foliage of legumes and grasses. It is especially severe on birdsfoot trefoil, and also occurs on alfalfa and tall fescue. The disease is most destructive in dense stands during hot, humid weather. Plants are weakened and may be killed when the mycelium of the fungus grows rapidly over the foliage. The leaves become matted to the stems, shoots are killed, and large sunken straw-colored lesions with irregular brown margins are produced on the stems. The lesions frequently girdle stems and cause death of the plant. Small tan to brown sclerotia sometimes develop on dead plant parts. These are structures which enable the fungus to survive for several years in the soil. Since the fungus is soil-borne and attacks a wide range of hosts, the only practical means of control is the development of resistant varieties.

Root and Seedling Blight Complex *(Pythium sp., Rhizoctonia sp.,* and *Fusarium sp.)*

The most important soil-borne (damping-off) fungi that attack legumes and grasses are species of Pythium, Fusarium, and Rhizoctonia. They occur throughout the world and attack a great variety of plants. There are two types of damping-off. PRE-EMERGENCE DAMPING-OFF rots the sprouting seed before it breaks through the ground. It is often observed as bare spaces in what should be uniform stands. A poor stand may be the result of low viability of seed, but more often it is due to damping-off fungi. Pre-emergence damping-off is most serious in cold, wet soils when seed germination is low. POST-EMERGENCE DAMPING-OFF is a rotting or wilting of seedlings soon after they emerge from the soil. Succulent stems have a water-soaked sunken zone at the ground level and the plants usually fall over. In woody seedlings the stems wilt but remain upright. Root decay usually follows. This type of damping-off is most common in warm, humid weather, especially when seedlings are crowded. Many fungi living saprophytically in the soil can also cause damping-off.

PHYTHIUM does its most severe damage in wet, poorly drained soil, especially early in the season during cool periods. Affected seedlings wilt rapidly and fall over when girdled. Soft rotted areas develop on the stems slightly below the soil surface. Symptoms on older plants are less conspicuous and consist of blackened, rotted root tips, brown collapsed areas along the lateral roots, or a general browning of the entire root system. Affected plants become pale green or yellow, stunted or weakened, and usually die.

RHIZOCTONIA is present in most soils and is usually destructive during the warmer parts of summer. This fungus causes damping-off and root rot on many legumes and grasses. The fungus is most destructive when the seed-

lings or older plants are weakened or are growing poorly because of unfavorable conditions.

Fusarium causes damage to grasses but not as severely as it does to legumes. Under favorable conditions Fusarium will attack the germinating seed and roots of grasses.

Several practices can reduce losses from damping-off, seedling blight, and root rot. Adequate applications of lime and fertilizer and thorough preparation of the seed bed will enable the young seedlings to emerge rapidly and grow vigorously. An adequate application of fertilizer will also strengthen older plants and help them resist attacks from root rotting organisms. Damping-off usually cannot be cured but it can be largely prevented by treating with a protectant chemical. Because most damping-off organisms live in the soil, chemicals are used to coat the seed so as to kill or inhibit the growth of the fungi in the soil immediately surrounding the seed and thus provide protection during germination. Seed treatment should be regarded as crop insurance. It is quite possible to get good stands without seed treatment, but it frequently helps materially in getting a good stand, especially if the soil is cold and wet. There are a number of seed-treating chemicals on the market. Some of them are Arasan, Ceresan, Semesan, Spergon, Captan, and Panogen. Directions for treating seed are found on the label of the container. These directions should be followed.

GENERAL GRASS DISEASES

Anthracnose *(Colletotrichum graminicola)*

Anthracnose is particularly noticeable in late summer and fall on many grasses as they mature. Sudan grass, however, is attacked in mid-summer at the height of its vegetative growth. If conditions are favorable for the disease, the fungus attacks seedlings, causing stunting, wilting, and sometimes death. Although relatively few seedlings are killed, damage to the roots usually results in a substantial reduction in yield. Plants may appear to recover as the season progresses. In other plants the leaf sheath is attacked; however, the fungus may spread into the crowns and roots of perennial grasses, causing stands to die out in the second or third year. The disease is especially severe in areas of low soil fertility. Early attacks cause a reduction in vigor and premature ripening or dying, resulting in shriveled seed. Lesions are usually light tan in color with a darker border of red or brown. If moisture conditions are suitable, fungus fruiting bodies develop within the bleached centers of the lesions on the dead leaves.

Infection occurs from diseased seed or from spores and mycelium that develop saprophytically on old crop residue. Infection is commonly found in the vicinity of plant nodes. After infection is established, secondary spread occurs from spores and mycelium. The anthracnose fungus is a high-temperature organism, growing best at about 82°F.

Control measures include crop rotation, particularly avoiding a sequence of closely related crops; maintaining soil fertility; completely turning under crop residues; and the development of resistant varieties.

Brown Stripe *(Scolecotrichum graminis)*

Brown stripe, also called brown streak and brown leaf blight, has been found on more than 140 grasses. Only smooth bromegrass is resistant. The

disease is particularly severe on orchard grass, timothy, tall oat grass, red top, and bluegrass. It also attacks cereals. The disease occurs throughout the growing season but is most destructive during mid-summer and autumn. Early attacks on very susceptible plants may cause withering and dying of leaves, greatly reducing the quality of forage. The fungus first produces circular to elongated water-soaked spots on the leaves, which later become deep, dull-gray in color. The shape, size and color of the lesions usually depends on the stage of growth of the plant attached. On older lesions narrow purplish-brown streaks appear, usually with an ashy-gray-white center. The lesions may be up to several inches in length and occur singly or coalesced. Within the lighter center of the lesions prominent black fungus growths appear as black dots in parallel rows. The fungus overwinters on dead leaves and tufts of grasses and infects new growth in the spring. Because of the broad host range of this disease the fungus has ample means of maintenance and spread. The destruction of dead grasses aids in reducing the overwintering inoculum but development of resistant varieties is the best ultimate solution for the control of brown stripe.

Ergot *(Claviceps purpurea)*

Ergot is a widely distributed disease, affecting the flowers of many grasses and cereals. The disease not only reduces seed yield and quality of the crop but the sclerotia (resting bodies) of the fungus contain a poison which is very harmful to animals. The sclerotia (ergots) which extend from the seed head are the most conspicuous indication of this disease. When mature, the sclerotia fall to the ground or are harvested with the seed. In the spring with abundant moisture, they produce spores which ripen as the new grass crop blooms and are spread by wind and insects to the open flowers. Instead of the normal formation of seed, a sticky clear liquid containing spores exudes from the flower parts. Insects, rain and wind spread these spores to flowers of other susceptible plants. Later in the season the infection enlarges and the fungus develops sclerotia. There are many races of the fungus, some of which are able to attack both grasses and cereals.

Sanitation practices are the most reliable means of control. Ergot-free seed is the first requisite. Crop rotation and mowing of roadside grasses before the "honeydew" stage is reached is next in importance in the reduction of infection. Resistant strains of various grasses have been selected.

Powdery Mildew *(Erysiphe graminis)*

Powdery mildew is most destructive on cereals but also occurs on many wild and cultivated grasses. Most commonly attacked are bluegrass, fescues, orchard grass, and bromegrass. The disease generally is not severe on grasses that are clipped regularly, but it may reduce yields in seed crops. Powdery mildew is favored by cool weather. Although many races of *E. graminis* have been reported, few are restricted to only one species of grass. Since several races may attack a single plant, there is ample opportunity for hybridization and the formation of new races. Powdery mildew attacks the aerial parts of plants but usually only the leaves are damaged. Powdery blotches develop, chiefly on the upper leaf surface. Orange or yellow areas develop beneath the powdery blotches. The dusty, mildew, blotches first white, later gray or buff, may completely cover the leaf, causing it to first turn yellow and then brown. The powdery masses consist of mycelium and numerous spores. Later, black fruiting bodies may develop.

The fungus overwinters primarily as mycelium on dead leaves and on winter grasses. Disease symptoms are usually evident in late spring when numerous spores are disseminated by the wind. The resting stages of the fungus, produced on dead plant tissue, maintain the fungus over hot, dry periods, when the disease apparently disappears. However, with cooler weather in the fall the disease may again become widespread.

Rusts

Several rusts occur on forage grasses in Virginia, reducing hay and pasture yield as well as reducing the quality of forage.

Two rusts occur regularly on orchard grass, causing considerable damage, particularly in late summer. The rust most frequently found is a form of *Puccinia graminis*, commonly called stem rust. This rust has not been definitely identified, but this form of stem rust does not attack small grains. Specialized forms also attack numerous grasses as well as small grains. The red rust stage develops on the leaves of grasses at any time during the growing season but is most predominant in late summer. As the rust infection develops the leaf epidermis is broken and pushed back by the pustules which contain golden brown masses of spores (Plate 4, B). The spores are wind-borne and spread the rust to other plants. In late fall diseased plants develop black overwintering spores. In the spring these overwintering spores produce a different kind of spore, which infects the alternate host. On this alternate host a still different type of spore develops and is blown to grasses later in the spring. Low temperatures and alternate freezing and thawing make ideal conditions for the germination of the spores from the alternate host, while moderate temperatures and moist conditions favor infection by the spore stage produced on grasses. The other rust commonly found on orchard grass is a leaf rust caused by *Uromyces dactylidis*. This leaf rust occurs in mid- to late-summer, especially in warm areas.

The two rusts mentioned above differ in the shape of their spores and therefore can be readily distinguished. Some resistance to these rusts, particularly to Uromyces, is found in the new Potomac variety of orchard grass. More highly resistant lines are being developed to both of these rusts and should be available soon.

Yellow leaf rust, caused by *Puccinia poae-nemoralis*, is the principal rust of bluegrass. It occurs primarily on the leaves where it produces orange-yellow pustules. This rust also attacks several other grasses but does not infect cereals. Orange leaf rust, caused by *Puccinia rubigo-vera*, has also been found on bluegrass. Common Kentucky bluegrass is more resistant to rust than Merion bluegrass, which is highly susceptible.

Scald *(Rhynchosporium spp.)*

There are several species of this fungus that attack grasses (Plate 3, lower right) and cereals. Although the disease usually is less prevalent and less destructive on orchard grass than are some of the other leafspots, it causes considerable damage when the lesions are abundant. Scald usually appears when plants are growing rapidly. It sometimes occurs late in the summer but seldom in the fall. Leaf lesions are oval, light tan to white, surrounded by a tan to reddish-brown border. Lesions vary from ¼ to 1 inch in length and may extend most of the width of the leaf blade.

Infection results from overwintering spores on the old dead leaves in the crown of the plant. Since there is considerable difference in susceptibility

between different grasses, it should be possible to develop resistant varieties if the disease becomes serious.

Stripe Smut *(Ustilago striiformis)*

Stripe smut occurs commonly on many grasses. The most important grasses attacked by one or more races of stripe smut are orchard grass, bluegrass red top, and timothy. Smutted plants may be found in pastures from May to November. Diseased plants frequently die during hot, dry weather. Because smutted plants are usually stunted, they may be easily overlooked in fields of uncut grass. The disease is first noticeable as long gray narrow streaks on grass blades, which later coalesce to form dark stripes extending the entire length of the leaf. As the smut lesion matures, the leaf tissue is ruptured and the blades curl and become shredded. Smut spores released from the shredded leaves are carried to the soil by wind and rain. Cool, moist weather in the spring and fall is most favorable for the development of stripe smut. Seedlings may become infected either from seed contamination or from spores in the soil. Since the mycelium is systemic it can overwinter in the crown of perennial grasses.

Other than crop rotation there are no adequate means of eliminating this fungus from the soil. Seed treatment with a mercury fungicide has given some control.

BLUEGRASS

Leafspot and Footrot *(Helminthosporium vagans)*

This fungus causes a leafspot and footrot on bluegrass and is probably the most common and serious disease of this host. The disease occurs in pastures and lawns in cool, humid areas. Pure thick stands of Kentucky bluegrass are more seriously affected than are mixed grasses. Damage from leafspot and footrot is accelerated by frequent close clipping, because succulent new growth is more susceptible to fungus attack. The application of nitrogenous fertilizers during the summer stimulates the formation of new growth, which in turn favors the development of the disease. Damage is also severe when a heavy mat of clippings or hay is left on the ground during humid weather.

The leafspot appears as purplish-black to reddish-brown lesions varying up to ½ inch in length, depending on the age of the lesion, susceptibility of the host, and size of the leaf. Older spots usually have a light center, surrounded by a red to brown or purple margin. Some lesions extend the width of the leaf blade, causing it to break over and wither from the tip to the point of attack. Frequently the leaf boot is diseased, with the flower heads inside being infected. Discoloration and blighting of the head results in diseased seed. If infection occurs at the base of the stem it frequently spreads down to the crown, causing browning of the tissues. This frequently results in a weakening, and death of the plant. Seedlings particularly are killed rapidly by stem infection. The disease develops best during cool, wet weather in the spring.

Infection occurs throughout the growing season from spores produced on the older lesions which spread by wind and rain to neighboring healthy leaves. The fungus overwinters in lesions on living leaves or as spores or mycelium on dead leaves. Chemical sprays are quite effective in controlling leafspot and footrot on lawns and park areas, but are not considered practical for field application. High clipping or mowing (1½ inches or more) reduces injury

from footrot by maintaining older leaves without stimulating the formation of new succulent shoots. Strains of Kentucky bluegrass differ in susceptibility to leafspot. Merion bluegrass is the most resistant of the bluegrasses.

BROMEGRASS

Brown Spot *(Helminthosporium bromi, Pyrenophora bromi)*

Smooth bromegrass is frequently damaged by brown spot (Plate 3, upper left). The fungus apparently attacks this host wherever it is grown. The fungus also attacks several other species of Bromus but no other grass. Infection is first noticeable as small, dark-brown, oblong spots on leaves in the spring. Older spots are somewhat elongated, dark-purple to brown, and surrounded by a yellow band or halo. The lesions may coalesce, forming large yellowed areas on the leaves. Severely infected leaves frequently die back progressively from the tip to the base. Brown spot develops best during cool, wet weather, reaching a peak in late May or early June. The disease spreads very little during hot, dry weather of mid-summer but becomes prevalent again in the fall.

Primary infection occurs early in the spring when spores discharge during cool, wet weather. The spores are carried by air currents to new leaves, where they germinate and penetrate directly through uninjured tissue. As the lesions mature a new crop of spores is produced, either on the lesion itself or, more frequently, on the discolored parts of infected leaves.

FESCUES

Net Blotch *(Helminthosporium dictyoides)*

Net blotch is one of the most common leaf diseases of tall and meadow fescues. Net blotch symptoms on fescues resemble those on barley caused by other species of the same fungus. Leaf lesions range from small, oval, brown spots to extensive brown, net-like streaks, which may cause complete withering of the leaves and sometimes death of the plant. Spores are spread by wind and splashing rain. The fungus is seed-borne, which may account for the occurrence of the disease in new plantings. At the present time there are no resistant varieties of fescue.

ORCHARD GRASS

Purple Leafspot *(Stagnospora maculata)*

Purple leafspot of orchard grass occurs in most areas of the country. Lesions appear on leaves as soon as new growth begins in the spring, developing during the summer except during prolonged hot, dry weather. The disease reaches a peak either shortly before or at the time of heading. Severely infected leaves may be killed. Even where orchard grass is grazed the leaves may become withered and brown from heavy attacks by the fungus. Severely affected orchard grass is greatly reduced in quality. Infection develops abundantly in the fall and new lesions can be found until late winter. The lesions usually first appear on small, somewhat elongated, blackish-brown to deep purple spots (Plate 3, upper right). When the lesions are abundant they coalesce, causing the leaf to turn brown and die. Frequently the browning develops at the tip of a leaf or along the margin in long, brown streaks. Infection occurs from spores that overwinter on dead stems and leaves. The

spores are spread by spattering rains and wind-blown fragments of infected plant parts. The fruiting bodies are usually formed in rows on the dead leaves.

Breeding or resistance apparently is the only practical means for controlling this disease. Although no immune plants have yet been found, sufficient resistance exists in some lines of orchard grass to suggest that they might be valuable for developing resistant varieties.

Yellow Slime Disease *(Corynebacterium rathayi)*

Yellow slime is a new disease of orchard grass in Virginia. It was first found in 1957. Yellow slime disease is serious from the seed producer's standpoint but will probably not be of particular concern to hay and pasture producers. Yellow slime disease reduces seed yield, since many seed heads are aborted. The chief concern relative to this disease is the danger of its spread to other areas by contaminated seed.

Symptoms of the disease are quite conspicuous and can be found from May to mid-June. A yellow bacterial slime appears on the surface of the plant and on the seed heads, causing a dwarfing and distortion of the affected part of the plant (Plate 4, A). Yellow slime may completely cover the leaves, stems, and flowers. Because of the sticky slime produced by the bacteria, stems often form knee-shaped crooks at the top nodes. These crooks are due to the elongation of the lower part of the stem when the flowers become cemented to the leaf sheath. Yellow slime disease has been reported only on orchard grass, rye, and Bermuda grass. Apparently the disease is more severe when wet weather occurs in early spring. The bacteria are carried on the seed; therefore, the disease is capable of developing anywhere contaminated seed is planted. The bacteria can survive on or in dry seed for at least 11 months, and probably longer.

Control measures have not been worked out; however, there are several suggestions that may be of considerable value in keeping the disease in check. All diseased orchard grass should be destroyed as soon as possible by plowing under and rotating with non-susceptible crops for at least three years. A row crop such as corn, should be planted the first year so that all voluntary orchard grass can be cleaned out. Small grains, with the exception of rye, can be used in the rotation. Pasture fields in the disease-infested area which are used for several years should be cut early to prevent flowering and seed formation. A clean source of seed should be used for planting.

SUDAN GRASS

Leaf Blight *(Helminthosporium turcicum)*

This disease is destructive to sudan grass, Johnson grass, and corn. It is less serious on sorghum. Leaf blight may attack sudan grass from mid-summer to plant maturity, being particularly damaging during and after warm, moist weather. Large, elongated spots, tan to reddish-purple, often with a dark margin, develop on the leaves. Later lesions increase in size and fade to gray or straw color, causing the leaves to appear blighted and scalded. Flower heads may also be attacked, and when this occurs the seed become infected.

The fungus overwinters on old plant debris; therefore, crop rotation should be of value in control. The results of field tests in other states indicate that treating the seed with a fungicide will also help materially in controlling leaf blight. Certain varieties of sudan grass have some resistance.

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